Roll No.											

PRESIDENCY UNIVERSITY

BENGALURU

End - Term Examinations – MAY /JUNE 2026

Date: 22-05-2026 **Time:**01:00pm – 04:00pm

School: SOE	**Program:** B. Tech. (Mechanical Engg.)	
Course Code: MEC3085	**Course Name:** Dynamics of Machines	
Semester: VI	**Max Marks**: 100	**Weightage**: 50%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**20**	**20**	**20**	**20**	**20**

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

Part A

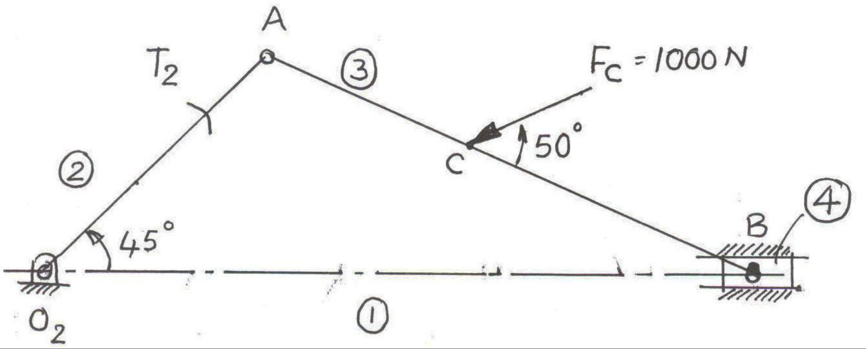
Answer ALL the Questions. Each question carries 2marks. **10Q x 2M=20M**

1.	State D Alembert's principle.	**2 Marks**	**L1**	**CO1**
2.	List any two basic problems in dynamics of machines.	**2 Marks**	**L1**	**CO1**
3.	What is a two-force member?	**2 Marks**	**L1**	**CO1**
4.	Why is the free body diagram the first step in analysis?	**2 Marks**	**L2**	**CO1**
5.	What is a turning moment diagram?	**2 Marks**	**L2**	**CO1**
6.	What is the fluctuation of energy?	**2 Marks**	**L1**	**CO2**
7.	Define the coefficient of fluctuation of speed.	**2 Marks**	**L1**	**CO2**
8.	State the primary difference between the function of a flywheel and a governor.	**2 Marks**	**L1**	**CO2**
9.	Interpret why a large positive loop appears during the expansion (power) stroke of an IC engine.	**2 Marks**	**L2**	**CO2**
10.	Explain the relationship between coefficient of fluctuation of speed and coefficient of steadiness.	**2 Marks**	**L2**	**CO2**

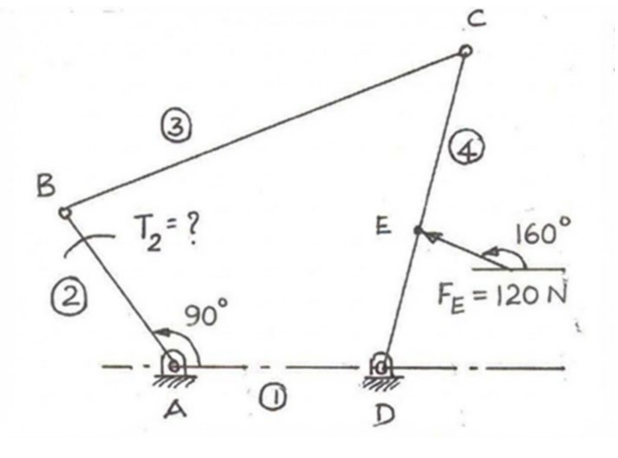
Part B

Answer the Questions. **Total Marks 80M**

<table>
<tr><td>11.</td><td>For the given slider-crank (crank=7cm at 45 deg, rod=15cm) subjected to a 1000 N force at 50 deg, AC=70mm, Deconstruct the system into free-body diagrams. Analyze the force transmission through the connecting rod to deduce pin reactions and the required equilibrium crank torque.



</td><td>10 Marks</td><td>L4</td><td>CO1</td></tr>
<tr><td colspan="5">Or</td></tr>
<tr><td>12.</td><td>For the given four-bar linkage (AD=50mm, AB=60mm, BC=100mm, DC=75mm, DE=25mm): Deconstruct the system into individual free-body diagrams. Analyze the transmission of the applied forces through the coupler to deduce all joint reaction forces and the exact equilibrium torque required on crank 2.



</td><td>10 Marks</td><td>L4</td><td>CO1</td></tr>
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<tr><td>13.</td><td>A shaft equipped with a flywheel rotates at 280 rpm and undergoes a cyclic torque variation between 800 N·m and 3200 N·m over a 3-revolution cycle: rising uniformly for 0.5 revolutions, remaining constant at the maximum for 1 revolution, decreasing uniformly for 0.5 revolutions, and staying constant at the minimum for the final 1 revolution. The flywheel has a mass of 550 kg and a radius of gyration of 650 mm. Analyze the turning moment diagram to determine the mean torque, power developed, maximum fluctuation of energy, and</td><td>10 Marks</td><td>L4</td><td>CO2</td></tr>
</table>

	the percentage variation of speed, while interpreting the flywheel's effectiveness in stabilizing the mechanical system.			
	Or			
14.	Analyze the sequence of turning moment diagram areas (+52, -124, +92, -140, +85, -72, and +107 mm^2) for a multi-cylinder engine operating at 600 rpm. Deconstruct the cyclic energy accumulation to pinpoint the exact positions of maximum and minimum kinetic energy. Given the diagram scales (1 mm = 600 N-m vertically; 1 mm = 3° horizontally), evaluate the necessary mass for a flywheel with a 0.5 m radius of gyration to restrict total speed fluctuations to within ±1.5% of the mean speed.	**10 Marks**	**L4**	**CO2**

15.	During a dynamic simulation for an aircraft stabilization system, evaluate a gimbal-mounted gyroscopic rotor. The system features a 5 kg uniform disc (150 mm diameter) spinning horizontally at a constant 1000 rpm. As the module undergoes a rapid maneuver, it forces the axle to precess uniformly about the vertical axis at 60 rpm. Given a tight 100 mm span between the supporting bearings, deconstruct the interacting static weight loads and the active gyroscopic couple. Analyze how these specific vectors combine to dictate the final resultant reaction forces at both bearing supports.	**10 Marks**	**L5**	**CO3**
	Or			
16.	During sea trials of a high-speed coastal patrol vessel, the ship executes a sharp left-hand evasive maneuver along a 75 m radius at 100 km/hr. The vessel's propulsion relies on an 8-tonne turbine rotor (radius of gyration: 0.6 m) spinning clockwise at 1800 rpm when viewed from the stern. Analyze the interacting angular velocity vectors to deduce the magnitude of the resulting gyroscopic couple.	**10 Marks**	**L5**	**CO3**

17.	During heavy seas, a vessel's 20-tonne turbine rotor (radius of gyration: 0.60 m) operates at 2000 rpm (clockwise from port/left). The ship experiences simple harmonic pitching, oscillating ±6 degree every 30 seconds. Deconstruct the harmonic motion profile to evaluate the maximum angular acceleration. Analyze the interacting momentum vectors during a bow rise to determine the peak gyroscopic couple and deduce its specific yawing impact on the hull.	**10 Marks**	**L4**	**CO3**
	Or			
18.	During rough seas, a vessel's 750 kg turbine rotor (radius of gyration: 250 mm) operates at 1500 rpm (clockwise from the stern). As the ship undergoes pitching at an angular velocity of 1 rad/s, deconstruct the interacting angular momentum and precession vectors during a bow rise. Analyze these components to deduce the magnitude of the	**10 Marks**	**L4**	**CO3**

	transmitted gyroscopic couple and evaluate its specific directional impact on the hull's stability.			

19.	**a.**	Summarize the differences between primary and secondary unbalanced forces in a reciprocating engine. Specifically, compare how often each reaches its maximum value during one crank revolution.	**5 Marks**	**L2**	**CO4**
	b.	Deconstruct the centrifugal force vectors for four rotating masses (205 kg, 295 kg, 245 kg, and 255 kg at respective radii of 0.18 m, 0.16 m, 0.24 m, and 0.28 m; successive angles 40°, 80°, and 130°). Analyze these components to deduce the magnitude and angular position for a balancing mass at a 0.22 m radius.	**15 Marks**	**L3**	**CO4**
		Or			
20.	**a.**	Describe the concept of a "reference plane". Explain its purpose when calculating the balancing requirements for several masses that are rotating in different planes.	**5 Marks**	**L2**	**CO4**
	b.	Deconstruct the centrifugal force vectors for four rotating masses (210 kg, 310 kg, 250 kg, and 270 kg at radii 0.22 m, 0.16 m, 0.26 m, and 0.32 m; successive angles 50°, 80°, and 140°). Analyze these components to deduce the magnitude and angular position for a balancing mass at a 0.25 m radius.	**15 Marks**	**L3**	**CO4**

21.	During an aircraft component design phase, evaluate the dynamic stability of a multi-stage compressor shaft. Four eccentric rotors (200, 300, 400, 200 kg; radii: 80, 70, 60, 80 mm; axial positions: 0, 300, 400, 700 mm) have successive angular spacings of 45°, 70°, and 120°. Deconstruct the generated force and couple vectors to deduce the precise corrective masses required at bearing planes X (100 mm) and Y (500 mm) to prevent catastrophic flight vibrations.	**20 Marks**	**L4**	**CO5**
	Or			
22.	During an aircraft design lab assessment, evaluate the dynamic balancing of a prototype turbine shaft carrying four eccentric rotor discs (A, B, C, D) spaced 600 mm apart. Discs B, C, and D have masses of 10 kg, 5 kg, and 4 kg, acting at radii of 125 mm, 200 mm, and 150 mm, respectively. Disc A operates at a 100 mm radius. Deconstruct the unbalanced forces and couples to deduce the exact mass of disc A and the relative angular positions of all four discs required to achieve complete dynamic equilibrium.	**20 Marks**	**L4**	**CO5**